Typical PhD Screening Exam Topics: Communications

1. PROBABILITY AND RANDOM PROCESSES

Basic Concepts of Probability Theory

Random Variables

- Functions of a Random Variable
- The Expected Value of Random Variables
- The Markov and Chebyshev Inequalities
- Transform Methods
  - The Characteristic Function
  - The Probability Generating Function

- Multiple Random Variables
- Sums of Random Variables
- The Central Limit Theorem

Random Processes

- Definition of a Random Process
- Specifying a Random Process
- Stationary Random Processes
  - Wide-Sense Stationary Random Processes
  - Wide-Sense Stationary Gaussian Random Processes
- Time Averages of Random Processes and Ergodic Theorems
- Analysis and Processing of Random Signals
- Power Spectral Density
- Response of Linear Systems to Random Signals
- Optimum Linear Systems
- Matched Filter

2. COMMUNICATIONS

Link budget analysis

Binary Digital Communications: BPSK, OOK, BFSK, and DPSK, baseband and passband waveforms, signal bandwidth, baseband line codes

Coherent demodulators for binary signaling and performance in AWGN

Noncoherent demodulators for binary signaling and performance in AWGN

Note: This list is provided only as a guideline to the student and may not be completely comprehensive. Examiners reserve the right to determine specific areas of concentration, and students may be examined on any topic that broadly relates to the area.

Intersymbol interference

Effect of noise on FM receivers, FM threshold, threshold extension using PLL and PM and FM with feedback, pre-emphasis and de-emphasis

Bandwidth efficient digital communications: CPFSK, QPSK, OQPSK, and MSK waveforms, signal bandwidth, receiver structure, performance in AWGN, comparison with binary signaling schemes

Carrier, phase, and symbol synchronization: Phase-locked loops, Costas loops, open loop symbol synchronizers, delay-locked loops

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